United States Patent [19]

Miyamoto et al.

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[45] **Mar. 18, 1975**

[54] **PROCESS FOR THE MANUFACTURE OF HAIR SPRING COLLET**

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[73] Assignee: **Citizen Watch Company Limited,** Tokyo, Japan

[22] Filed: **Mar. 7, 1974**

[21] Appl. No.: **449,102**

Related U.S. Application Data

[63] Continuation of Ser. No. 283,758, Aug. 25, 1972, abandoned.

[30] **Foreign Application Priority Data**

Aug. 26, 1971 Japan 46-64763

[52] **U.S. Cl.** **29/178,** 29/412, 29/430, 58/115

[51] **Int. Cl.** **B23p 13/00**

[58] **Field of Search** 29/178, 177, 412, 429, 29/430; 58/115

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Primary Examiner—C. W. Lanham
Assistant Examiner—Victor A. DiPalma
Attorney, Agent, or Firm—Holman & Stern

[57] **ABSTRACT**

An improved spiral spring collet having a spiral surface for guidance and attachment of the inner end portion of a hair spring in which the collet has configuration parts including said spiral surface, pressingly shaped by a series of successive press steps.

6 Claims, 13 Drawing Figures

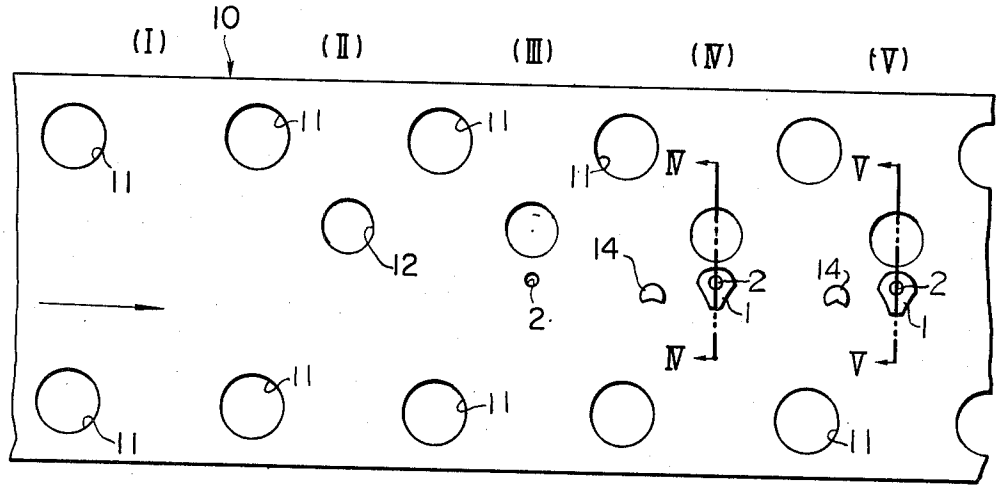


FIG. 1

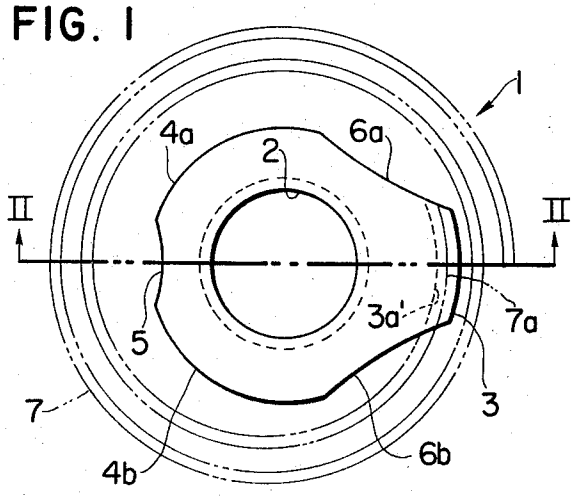


FIG. 2

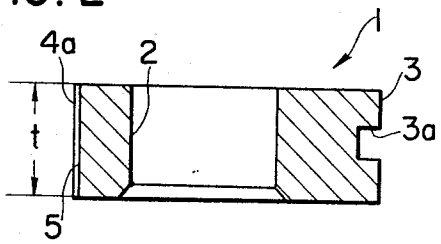
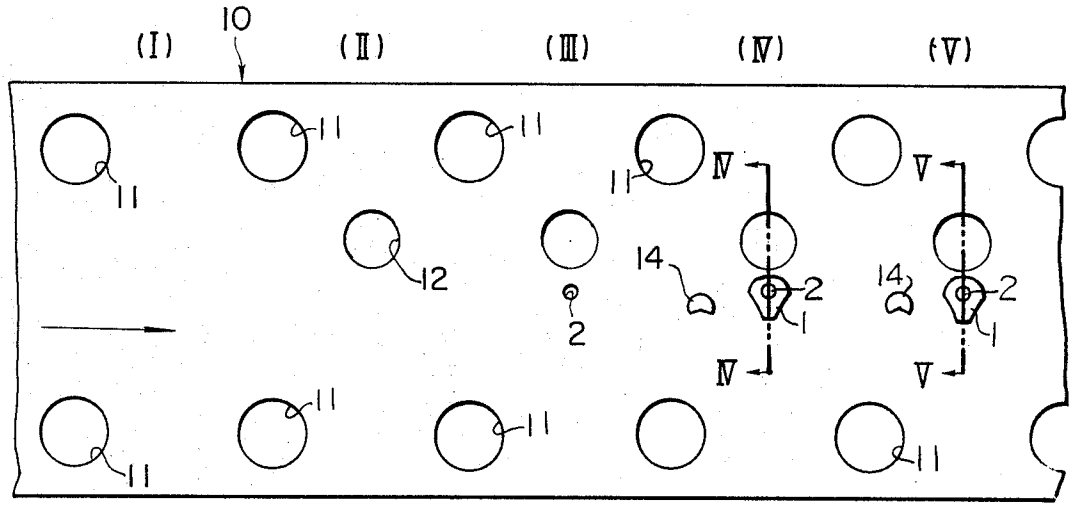


FIG. 3



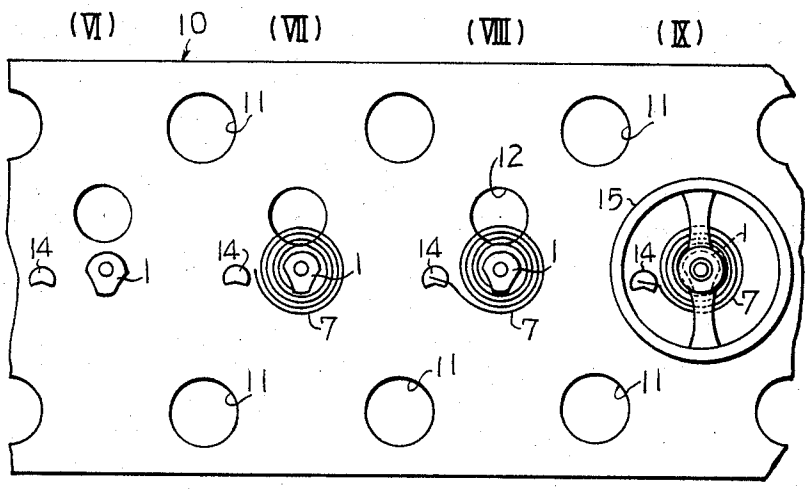


FIG. 4

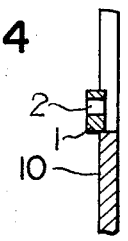


FIG. 5

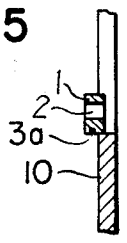
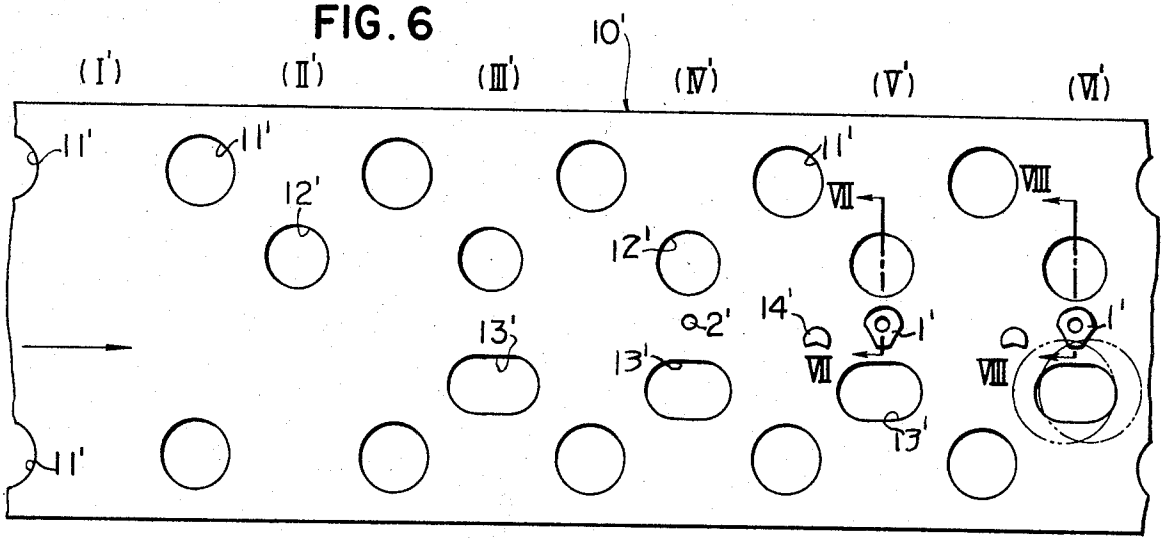


FIG. 6



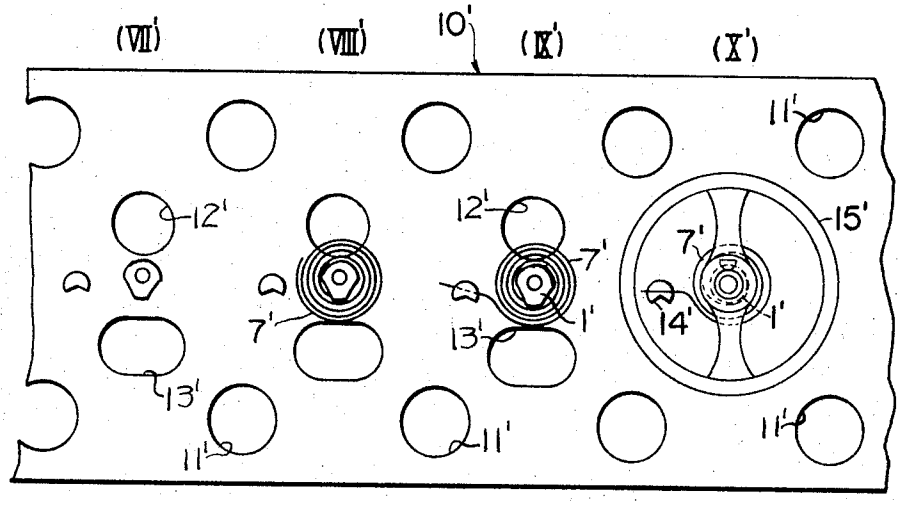


FIG. 7

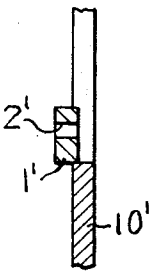


FIG. 8

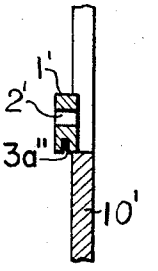


FIG. 9

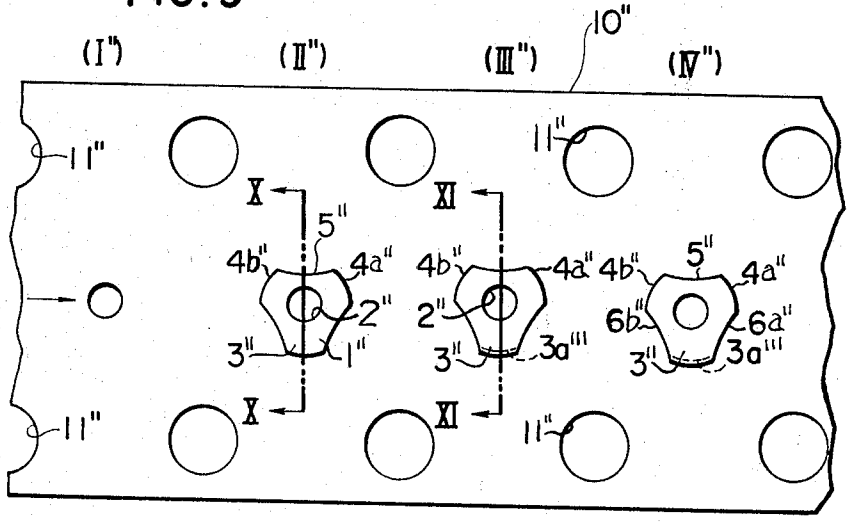


FIG. 10

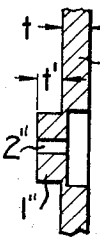


FIG. 11

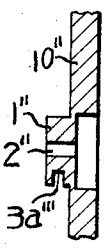


FIG. 12

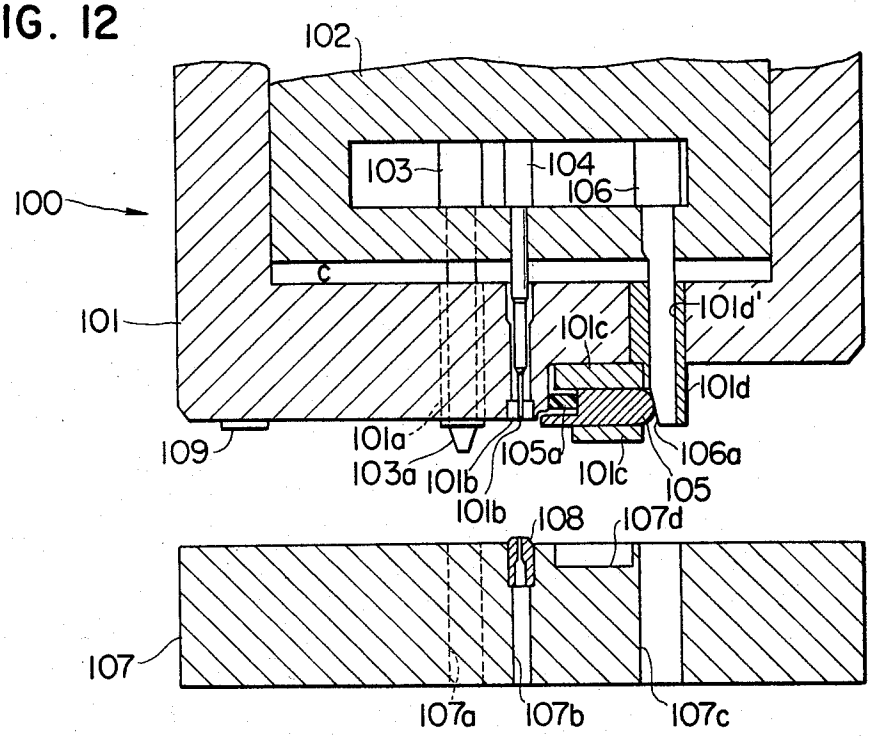
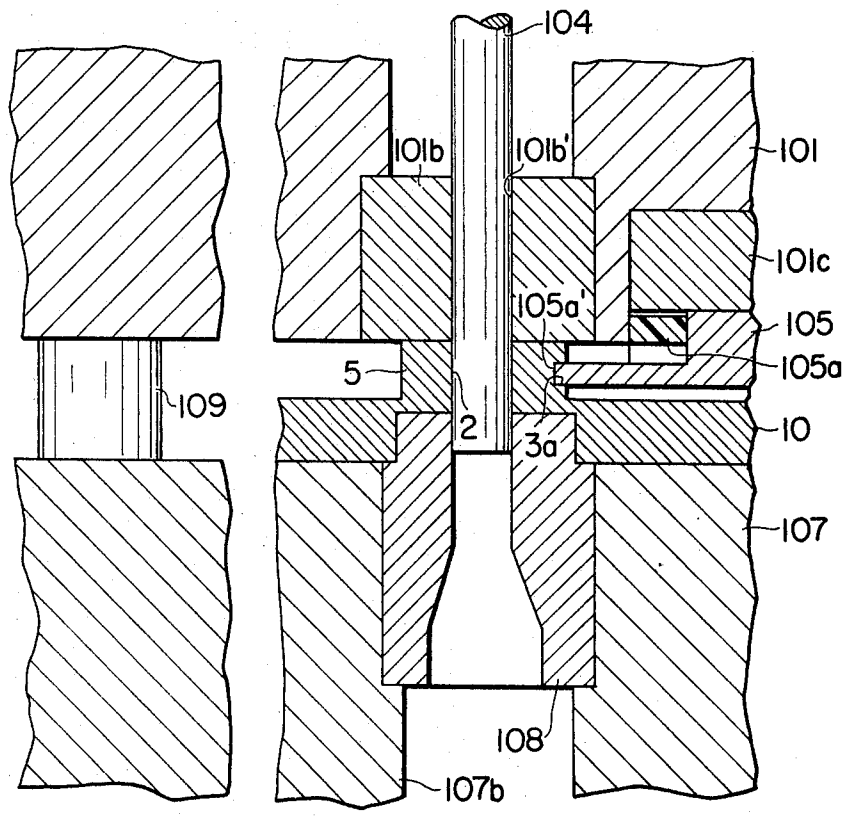

102
103
104
106
100
C
101
101d'
101c
101d
109
101a
103a
101b
105a
101c
106a
105
101b
108
107d
107
107a
107b
107c

FIG. 13


104
101b
101b'
101
101c
105a'
105
105a
5
109
2
3a
10
107
108
107b

PROCESS FOR THE MANUFACTURE OF HAIR SPRING COLLET

This a continuation of application Ser. No. 283,758, filed Aug. 25, 1972, now abandoned.

BACKGROUND OF THE INVENTION

This invention collet to improvements in and relating to a hair spring collect and a process for the manufacture of same.

The time-keeping accuracy of a timepiece depends among other things upon the oscillation isochronism of a time base, especially the balance wheel. The balance wheel is fitted generally with a spiral hair spring. It is a requisite requirement for attaining the isochronism to position the origin of the spiral configuration of the hair spring at the center of a central bore or opening drilled through the collet.

PRIOR ART

The conventional hair spring collet is formed with a slit for attachment of the inner end portion of the hair spring and it is impossible to attain the attaching requirement for the spiral spring only by attaching fixedly the inner end portion thereof to the slit of the collet. A troublesome and time-consuming additional adjusting job called "centering" must be carried out so as to properly bend the portion of the hair spring in close proximity to the fixedly attached inner end portion of the spring, and such, generally has been accomplished manually by skilled personnel.

In order to obviate the above conventional drawback, it has been proposed rather recently by a third party to provide the collet with at least a spiral surface or groove for attachment of the inner end of the spring, thereby dispensing with the time-consuming centering job. Difficulty has been encountered, however, especially in the manufacture of the collets on an industrial scale, particularly in the machining of the unsymmetric and irregular-shaped projection(s), cutout(s), shoulder(s) and/or complex curved surface(s) on the collet, inviting highly complicated and time-consuming setups and machinings steps.

OBJECTS AND SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an improved spiral hair collet, capable of manufacture in a highly efficient and easy way.

A further object of the present invention is to provide an improved hair spring collet of the above kind, capable of machining through a press job, a stamping job combined therewith or a milling job combined with a press job and in a highly simple way.

A further object is to provide a process adapted for the manufacture of said kind of collet in a simple and economical way.

These and further objects, features and advantages of the invention will become more apparent when read in conjunction with the following detailed description of the invention by reference to the accompanying drawings illustrative of several preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a top plan view of a preferred embodiment of the hair spring collet embodying the principles of the invention, wherein, however, a hair spring attached thereto is shown only partially and in imaginary lines,

FIG. 2 is a cross-sectional view of the collet shown in FIG. 1, wherein the section is taken substantially along a section line II—II shown therein,

FIG. 3 is a schematic and diagrammatic representation of a series of machining steps adopted for the manufacture of said collet, wherein however, the scheme has been shown in three parts arranged in substeps on account of the limitation of size of the drawing paper,

FIG. 4 is a sectional view taken along a section line IV—IV shown in FIG. 3,

FIG. 5 is a sectional view taken along a section line V—V shown in FIG. 3,

FIG. 6 is a schematic and diagrammatic representation of a series of press job steps adopted for the manufacture of the hair spring collet and in accordance with a second mode of the manufacturing process,

FIG. 7 is a sectional view taken along a section line VII—VII shown in FIG. 6,

FIG. 8 is a sectional view taken along a section line VIII—VIII shown in FIG. 6,

FIG. 9 represents a schematic diagram showing a further example of a series of the manufacturing steps abandoned.

collet according to this invention,

FIG. 10 is a sectional view taken along a section line X—X shown in FIG. 9,

FIG. 11 is a similar view to FIG. 10, taken along a further section line XI—XI shown in FIG. 9,

FIG. 12 is a longitudinal section through a pair of mating dies which are adapted to be used in the third step included in the collet-manufacturing process shown schematically in FIG. 9, and

FIG. 13 is an enlarged view of a part of FIG. 12.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Referring now to FIGS. 1 and 2, illustrative of a preferred embodiment of the hair spring collet according to this invention, numeral 1 represents generally the collet formed with a central bore 2 for attachment to a conventional balance wheel arbor, not shown. The collet 1 is further formed with a radial projection 3 for the attachment with an inner end portion 7*a* of a spiral hair spring which is shown partially and schematically in a chain-dotted line at 7. The spring guide projection 3 is formed with a spirally extending guide groove 3*a*, a the groove bottom is shown at 3*a'*. Substantially in diametral opposition to the radial projection 3, the collet 1 is formed with a momentum balance-adjusting cutout 5 having a slightly concave configuration when seen in the top plan view (FIG. 1) of the collet.

When seen in FIG. 1, a pair of convex curved peripherally extending projections 4*a* and 4*b* are formed on the collet at the both sides of the concave cutout 5, serving for a momentum balancing purpose. The collet 1 is further formed with cutouts 6*a* and 6*b* extending between the projections 3 and 4*a* and 3 and 4*b*, respectively, and in practice, defining substantially the radial projection 3 at both sides thereof. In the present embodiments, the outer peripheral surfaces of all the projections 3, 4*a* and 4*b*, and the configuration curves of cutouts 5, 6*a* and 6*b* represent respective circular arcs. When necessary, however, part or whole of each of these circular arcs may be replaced by a straight line or a broken straight line although not illustrated. The spi-

ral surface of groove bottom 3*a'* may be, when necessary, replaced by a similar circular arc to said spiral and concentric with the center of the central bore **2.** In place of the provision of the spirally extending groove 3*a*, the outer peripheral surface per se may be so formed as to represent a spirally extending one. The spiral form of the groove 3*a* or alternatively of the outer peripheral surface, when spirally formed, may be attached fixedly with the inner end 7*a* of hair spring **7** by conventional attaching means such as glueing or the like, and a later manual adjustment for correctly centering the spring end portion or the like can be eliminated.

Although the improved collet **1** has a specifically selected configuration for attachment of the spiral spring in the manner for assuring optimum and undisturbed periodical oscillation of the balance wheel, the collet can be easily manufactured in the following way:

Now, referring to FIG. **3, 4** and **5,** a preferred embodiment of the manufacturing process and a method for the attachment thereof to a balance wheel will be described in detail.

In FIG. **3,** (I), (II) ..... (IX) represent a series of successive machining steps.

At the first machining step (I), a sheet stock **10,** having a thickness of 0.4 mm and a width of 15 mm, is punched through so as to form two upper and lower regular series of pilot holes **11,** positioned in proximity to the upper and lower side edges of the sheet **10** when seen in FIG. **3** for the convenience of intermittent longitudinal feed of the sheet in the direction of the small arrow appearing on FIG. **3.** The diameter of each of the pilot holes **11** may preferably be 2.5 mm, and the pitch between two successive holes **11** may preferably be 7 mm. These upper and lower pilot holes **11** separated at 10 mm laterally are punched out one for each upper or lower series at one step. The feed rate may be preferably 45 mm per second.

At the second step, a series of auxiliary holes **12** having a diameter of 2 mm is punched out in succession at a pitch of 7 mm. These holes **12** define the cutout **5** and are adapted for cooperation with a certain supporting member used at the machining steps. This series of holes **12** is arranged in parallel with the longitudinal axis of the sheet stock **10,** as in the case of the foregoing pilot holes series.

At the third step (III), the central bore **2** which may have a diameter of 0.5 mm, is roughly punched through.

At the fourth step (IV), the outlines of collet **1** and a hair spring stud **14** are punched half way, as may be seen in FIGS. **4** and **5.**

At the fifth step (V), the spring guide groove 3*a* is formed through a lateral pressing operation which may be called "side coining."

At the sixth step (VI), the central bore **2** is finishingly punched through.

At the seventh step (VII), the inner end portion 7*a* of hair spring **7** is fixedly attached to the groove 3*a* by the caulking technique under pressure.

At the eighth step (VIII), the opposite end part of the hair spring is attached to the stud **14.**

At the ninth step (IX), a balance wheel **15** is attached from above.

At the tenth step, not shown, the collet and the stud are completely punched out.

A second mode of the manufacture of the collet according to this invention will now be described by reference to FIGS. **6–8.**

In these figures, corresponding parts or constituents to those employed in FIGS. **3–5,** are denoted with respective same reference numerals, yet each having a prime for easy comparison and better understanding.

In this second mode, and at the first step (I') thereof, the sheet stock **10'** is punched through the upper and lower series of pilot holes **11',** as before.

At the second step (II'), a series of auxiliary holes **12'** are punched out as before.

At the third step (III'), a series of second auxiliary holes **13** are punched out in parallel to the longitudinal axis of said sheet stock **10'.** Each of these holes **13** serves for allowing a milling cutter shaft to perform a pivotal movement, as will be described hereinbelow.

At the fourth step (IV'), central bore **2'** is roughly punched out as before.

At the fifth step (V'), outline configurations of collet **1'** and stud **14'** are semi-punched, as before.

At the sixth step (VI'), guide groove 3*a''* is machined with a milling cutter which is fitted additionally to the press machine, as shown in FIG. **8** in combination with a double headed arrow shown in FIG. **6.**

At the seventh step (VII'), central bore **2'** is finishingly punched out.

At the eighth step (VIII'), the inner end of hair spring is fixedly attached to spiral groove 3*a''* by caulking or a like measure, as before.

At the ninth step (IX'), the opposite or outer end part of the hair spring is fixedly attached to the stud, as conventionally.

At the tenth step (X'), the balance wheel **15'** is attached in position from above.

Next, referring to FIGS. **9–11,** a third mode of the process for the manufacture of the spiral spring collet according to this invention will be described in detail. In this case, same or similar constituents are denoted with the respective same reference numerals, yet each having two primes.

At the first step (I''), two series of pilot holes **11''** and central bores **2''** are successively punched out through a sheet stock **10''.** Central bore **2''** is roughly punched as before.

At the second step (II''), as seen from FIG. **10,** the outline of collet **2''** is semi-punched out, as before.

At the third step (III''), the central bore **2''** is preferentially and finishingly punched and spiral groove 3*a''* is formed through a lateral pressing operation, as shown in FIG. **11.**

At the fourth step (IV''), the collet is finally and completely punched out of the sheet stock.

Further steps may be carried out as before, although not specifically shown and described.

A die assembly, generally shown at **100,** which is adapted for use at the foregoing third step in the third mode of the collet manufacturing process will be described hereinbelow, and by reference to FIGS. **12** and **13.**

In these figures, numeral **101** denotes a jig plate which can move up-and-down under timed control and by a certain drive mechanism, not shown.

A block member **102** is slidably mounted in the jig plate **101** and is movable relative to the latter within a specific vertical distance shown at C.

Numeral **103** denotes a pilot pin, the upper root end of which is mounted in and fixedly attached to the block **102** and passes loosely through a guide opening **101***a* formed through the bottom wall of the jig plate **101.** The pilot pin protrudes by its lower tip end from the guide opening **101***a* and is formed with a tapered and substantially pointed tip end **103***a*. Numeral **104** represents a punching tool, the upper root end of which is mounted in and fixedly attached to the block **102** and which passes through a guide opening **101***b'* of a holder bushing **101***b* press fitted in the jig plate **101.** The lower tip end of the punching tool **104** is normally held in such position that the lowermost extreme end of the tool registers normally with the bottom surface of jig plate **101.** This punching tool **104** is used for punching of the central bore **2, 2'** or **2''** shown and described in the foregoing.

A laterally movable punching tool **105** is provided for the formation of the guide groove **3***a*, **3***a'* or **3***a''* and is laterally or horizontally movable by being held in position by means of a holder piece **101***c* which is mounted on the jig plate **101.** By the provision of a resilient back-up member **105***a* which is inserted between the tool **105** and jig plate **101,** the punch 1s urged to move to the right in FIG. **12.**

A pressure pin **106** is provided, the upper root end of which is, as in the case of pilot pin **103,** mounted in and attached fixedly to the block **102.** This pin **106** is slidably guided in the bore **101***d'* of a holder bushing **101***d* pressure fitted to the jig plate **101.** A lower tapered surface **106***a* formed on the lateral punch is normally kept in pressure contact with the tip end of the punching tool **105.**

Numeral **107** represents a die plate which is formed with a pilot pin hole **107***a*, die hole **107***b*, pressure pin hole **107** *c* and an escapement groove **107***d* for the holder **101***c*.

Numeral **109** represents a stop or spacer projecting a predetermined distance equal to the thickness *t* of the sheet stock **10** plus at least the half-punching height *t'* (see, FIG. **10**) from the bottom surface of jig plate **101.**

The operation of the die assembly shown in FIGS. **12** and **13** is as follows:

When the band-like sheet stock **10** is fed on the upper surface of die plate **107,** FIG. **12** towards the viewer, or more specifically in the direction shown by a small arrow in FIG. **9** and by a pitch length as determined by the pilot holes series from and the position of the second step II'', and kept stationary at this new position.

Then, the jig plate **101** is lowered until stop **109** is brought into engagement with die plate **107,** and the pilot pin **103** passes through the pilot opening **11,** into the reception opening **107***a* of die plate **107,** so as to precisely position the stock against unintentional movement thereof.

Next, when the block **102** descends in the range of the spacing C, the vertical punch **104** will enter into the roughly punched central bore **2''** and pass completely therethrough for performing a finish punching job. With further lower movement of the block **102,** the pressure pin **106** acts upon tool **105** which is thus urged to move to the left against the action of resilient member **105***a*, so the lefthand extreme end **105***a'* of said tool **105** is brought into pressure engagement with the outer peripheral surface of the projection **3''** of collet **1''** to form the spiral groove **3***a'''*. This function may be most clearly understood by reference to FIG. **13** in combination with FIGS. **10** and **11.**

When the block **102** moves upwards by the distance C, the punch **104,** pin **106** and tool **105** will assume their respective regular positions. With upward movement of the jig plate **101,** the pilot pin **103** will disengage from pilot pin **11''** and thus, the third step operation has been completed. Then, the stock **10** is fed by one step so as to occupy its fourth step position, and so on.

According to the present invention, the collets can be precisely and accurately produced yet at an amazingly rapid speed. As an example, a collet of the conventional design must consume about 25 seconds for the manufacture thereof, while according to the novel teachings of the invention, three pieces of collets can be manufactured per second.

The embodiments of the invention in which an exclusive property or privilege is claimed are as follows:

1. A process for the manufacture of a series of spiral spring collets, each having parallel front and rear surfaces, a central bore for attachment to a balance wheel arbor and at least one radial projection having a spiral surface for attachment of an inner end portion of a hair spring comprising the steps of

1. continuously feeding a sheet stock at a constant speed,
2. punching a series of pilot holes longitudinally along each side edge of the sheet stock at regular pitches and at a small distance from said edges,
3. punching-roughly a series of smaller central bores in the sheet stock,
4. punching half-way through the sheet stock a series of outlines of collets,
5. forming a spring guide groove on each of said halfway punched-out collets,
6. punching-finishingly through the rough-punched central bores in succession, and
7. punching through the collets in succession.

2. The process as claimed in claim **1,** in which step **5** is a side coining step.

3. The process as claimed in claim **1** in which step **5** includes punching out substantially elliptical openings in succession and forming the spring guide groove by milling with reference to each of the elliptical openings.

4. A process for the manufacture of a series of spiral spring collets, each having parallel front and rear surfaces, a central bore for attachment to a balance wheel arbor and at least one radial projection having a spiral surface for attachment of an inner end portion of a hair spring comprising the steps of

1. continuously feeding a sheet stock at a constant speed,
2. punching a series of pilot holes longitudinally along each side edge of the sheet stock at regular pitches and at a small distance from said edges,
3. punching a series of auxiliary holes in the sheet stock in an alternating arrangement to the pilot holes and at a laterally offset distance from either pilot hole series,
4. roughly punching a series of smaller central bores in the sheet stock in lateral registration with the auxiliary hole series,
5. punching half-way through the sheet stock a series of outlines of collets and a series of outlines of hair spring studs alternately and in proximity to the auxiliary holes,

6. forming a spring guide groove on each of said half-way punched-out collets,
7. finishingly punching through the half-way punched central bores in succession,
8. attaching inner end portions of hair springs fixedly to the grooves in succession,
9. attaching the outer end portions of the hair springs to the studs in succession,
10. attaching balance wheels to the collets, and
11. punching through the studs and collets in succession.

5. The process as claimed in claim **4**, in which step **6** is a side coining step.

6. The process as claimed in claim **4**, in which step **6** includes punching out substantially elliptical openings in succession and in lateral registration with the auxiliary holes and forming the spring guide groove by milling with reference to each of the elliptical openings.

* * * * *